

Negros Occidental Province
City of Sagay

Summary Report

Republic of the Philippines

Verification Survey with the Private
Sector for Disseminating Japanese
Technologies for
Portable All-in-one Water Purification
System

August 2016

Japan International Cooperation Agency

INADA Inc.

1. BACKGROUND

The coverage of water supply system in Negros Occidental Province is about 53% (as of 2012). Most of the residents in the area with poor water supply use underground water for drinking purpose. Due to poor sanitation, underground water is generally contaminated and hence, water supply systems and people`s health is in threat.

In November 2013, typhoon Yolanda hit the Philippines and caused severe damage in Negros Occidental Province. It also devastated available water sources and this has made the supply of drinking water in the Province an urgent issue. Besides, the province is very prone to frequent natural disaster and as a part of preparedness for such emergencies, local governments need a suitable system of water supply.

2. OUTLINE OF THE SURVEY

(1) Purpose

The Survey is conducted to verify the operation and maintenance of “AQUA CUBE”, a Portable All-in-one Water Purification System, to make clean and safe drinking water accessible to residents in 2 barangays located in Sagay City that does not yet have a proper water supply.

In this survey, AQUACUBE is installed to purify raw water from locally available water sources like river and irrigation canals into clean and safe drinking water. This project will not only contribute the local residents by supplying potable water at an affordable price but also help prevent various diseases caused by contaminated water, and improve their living condition.

This survey will also include preparation and demonstration of emergency water supply system by using AQUA CUBE during the occurrence of disasters.

The main outcomes of the Survey were as follows.

- a) Produced potable water by purifying nearby available water sources and distribute the potable water at an affordable price to the local residents of Barangay Colonia Divina, and Barangay Baviera. Establish and demonstrate water supply system using AQUA CUBE in the case of disasters.
- b) Verified the operation of AQUA CUBE and clarify its advantages over other

existing water supply systems. Obtain the understanding of water purification efficacy of AQUA CUBE from Negros Occidental provincial government, Sagay City, Water District and other LGUs.

- c) Formulated suitable deployment method of AQUA in Sagay City, Negros Occidental Province and all over the Philippines to contribute in water supply system.

(2) Activities

The main activities of the survey was as follows.

① Demonstration and Verification of AQUA CUBE.

Preparation of AQUA CUBE

- a Analyze the appropriateness of AQUA CUBE for the target area of the Survey.
- b Place order for AQUA CUBE to Murakami Manufacturing CO., LTD. and check the operation of those before shipping from Japan to Republic of the Philippines.
- c Prepare the manual of operation, maintenance and inspection for Sagay City.

Verification of AQUA CUBE

- a Analyze the water purification cost (operation and maintenance cost) and survey the purchase capacity and willingness of the residents for drinking water.
- b Set up AQUA CUBE in two sites without water supply system (Barangay Baviera and Barangay Colonia Divina) and demonstrate its operating capacity to treat and purify river water, rain water or agricultural water to safe drinking water.
- c Analyze the environmental impact of AQUA CUBE.
- d Decide how to disclose the way of setting prices for the purified drinking water and the water quality.
- e Decide how to sell purified drinking water.
- f Submit the proposal to Sagay City for the water supply system with AQUA CUBE at other barangays near Barangay Baviera and Barangay Colonia Divina.
- g Sell purified drinking water at an affordable price to residents. At the same time, collaborate with Sagay City to adopt the security measures to protect purified water and AQUA CUBE.

- h Analyze the quality of raw water and water purified by AQUA CUBE and assess the outcome of the result of purification objectively.

Counterpart Training

- a For appropriate operation and maintenance by Sagay City after the Survey, offer the capacity building assistance to Sagay City on the series of operation and maintenance, such as the way of selecting and the quality of raw water appropriate for purification by AQUA CUBE, performance management with numerical index of the water purification business, and so on. Organize the way of water purification and sales areas after the survey with Sagay City.
- b Receive appropriate counterpart personnel in Japan for their learning the equipment and the system of AQUA CUBE as well as water supply technologies and systems in Japan.

Establishment of the system at the time of disaster

- a Establish the water supply system at the time of disaster to ensure the supply of drinking water with AQUA CUBE with collaboration of Sagay City and related entities.
- b Simulate the emergency cases and verify the procedures and capacity of Sagay City to supply drinking water urgency at a pilot site in Sagay City.

② Dissemination of AQUA CUBE.

- a Make a comparison of the costs between AQUA CUBE and other water supply methods such as water supply by water tank truck, replacement of deteriorated water pipelines and laying new water pipelines.
- b Conduct dissemination activities such as workshops to appeal the advantages of AQUA CUBE for Negros Occidental provincial government, Sagay City Water District, the neighboring residents based on the results of drinking water supply business conducted by Sagay City.
- c Investigate the laws and regulations regarding water supply and raw water of other local governments and conduct hearings on water supply with other local governments.
- d Conduct dissemination activities such as workshops to appeal the advantages of AQUA CUBE for the local government and water suppliers which are most likely to purchase.

③ Formulation of the plan to disseminate AQUA CUBE

Formulate the plan further to disseminate AQUA CUBE in Sagay City and other areas after the Survey.

(3) Information on Product/Technology to be provided

All-in-one water purification system, “AQUA CUBE” is a water purification device that includes Microfiltration (MF) membrane, activated carbon absorption tower, and chlorine disinfection system. It also has a built-in power generator.

The features of Aqua Cube are as follows.

- Large capacity of water purification:
The purification capacity of AQUA CUBE is about 2,000 L/hour. It can produce potable water for about 600 people in 1 hour (3L/person/day).
- Efficient application of MF membrane:
AQUA CUBE is installed with Microfiltration (MF) membrane having permeation pore size of 0.02µm. It can completely filter various bacteria, Escherichia coli, suspended solids, floating materials and other pollutant components.
- Energy efficiency and easy maintenance:
AQUA CUBE has simple operation and maintenance procedures. Therefore, it can be operated by anyone without special technical training. It also has automatic cleaning function with minimum water loss. Due to this, the MF membrane can be used for a long term (more than 5years). The discharged water after automatic cleaning of the membrane can be directly released into the natural environment as there is no chemical pretreatment.
- High mobility:
AQUA CUBE is compact and can be loaded on a truck and carried to different locations. It can use locally available water sources as raw water to produce potable water. Therefore, it can be highly useful to supply safe drinking water in case of disasters.

The following are comparative superiorities of AQUA CUBE.

- It can purify a large amount of water by consuming less energy.
- It can easily remove bacteria, protozoa, algae, chromaticity and turbidity.
- It can undergo full automatic operation even under high-turbidity of raw water without flocculants.

(4) Counterpart Organization

Sagay City is the counterpart organization and it undertook the following responsibilities.

- i. Operation and maintenance of AQUA CUBE during and after the survey period.
- ii. Implementation of water supply business using AQUA CUBE.
- iii. Management of sales, revenue and expendable supplies such as fuel, chlorine and activated carbon filters of Aqua Cube.
- iv. Monitoring and logging of daily sales, revenue, operation period, and daily water quality test parameters. Reporting of these data to INADA Inc. during the survey period.
- v. Preparation of suitable framework to distribute potable water using AQUA CUBE mainly during disaster occurrence. Also, conduct necessary drills to verify required manpower, transportation method of AQUA CUBE and time requirement, water sources etc. to ensure smooth operation during emergencies.

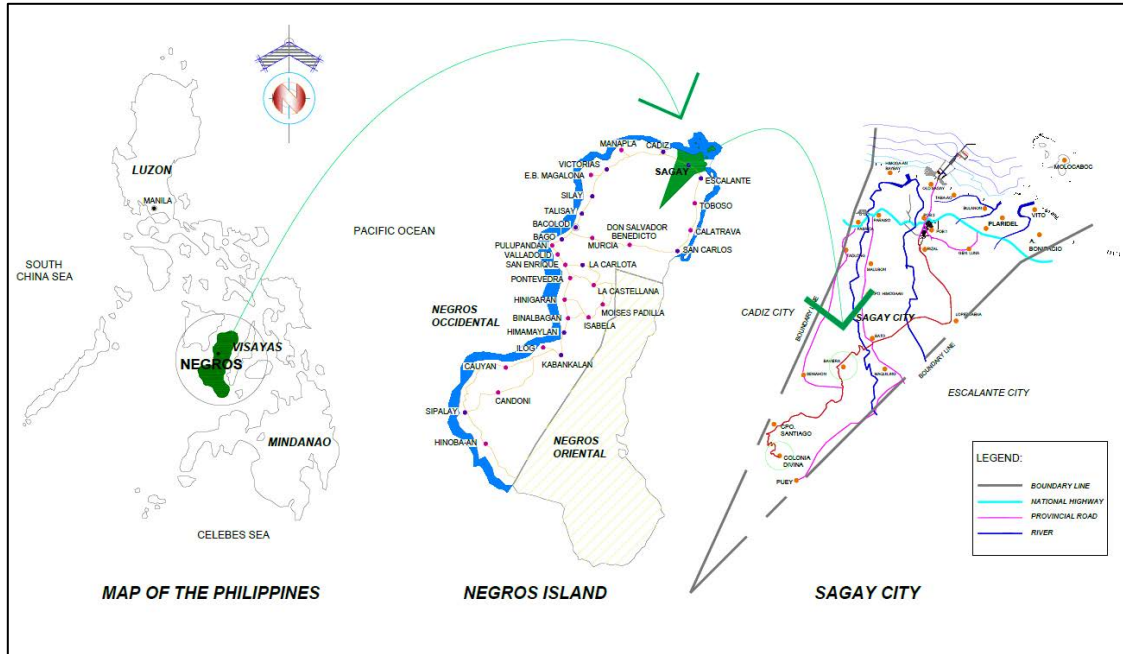
(5) Target Area and Beneficiaries

| | Barangays | Population | Number of Households |
|---|-------------------------------------|------------|----------------------|
| 1 | Barangay Colona Divina ¹ | 3,306 | 616 |
| 2 | Barangay Baviera ² | 3,056 | 572 |

¹ Data as of December 2013

² Data as of November 2014

Figure 1: Location of the target areas in Sagay City



(6) Duration

From January 2015 to August 2016

(7) Progress Schedule

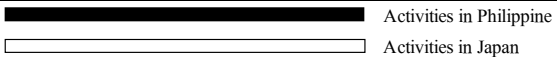
Table 1: Progress Schedule

| Survey topics | 2015 | | | | | | | | | | | | 2016 | | | | | | | |
|---|------|-----|-----|-------|-----|------|------|-----|------|-----|-----|-----|------|-----|-----|-------|-----|------|------|-----|
| | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec | Jan | Feb | Mar | April | May | June | July | Aug |
| (1) Demonstration and Verification of AQUA CUBE. | | | | | | | | | | | | | | | | | | | | |
| a Analyze the appropriateness of AQUA CUBE for the target area of the Survey. | ■ | ■ | | | | | | | | | | | | | | | | | | |
| b Place the order for AQUA CUBE to Murakami Manufacturing CO., LTD. and check the operation of those before the shipping from Japan to Republic of the Philippines. | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | |
| c Prepare the manual of operation, maintenance and inspection for Sagay City. | | ■ | ■ | | | | | | | | | | | | | | | | | |
| Verification of AQUA CUBE | | | | | | | | | | | | | | | | | | | | |
| a Analyze the water purification cost (operation and maintenance cost) and survey the purchase capacity and willingness of the residents for drinking water. | ■ | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| b Set up AQUA CUBE in two sites without water supply system (Barangay Baviera and Barangay Colona Divina) and demonstrate its operating capacity to treat and purify river water, rain water or agricultural water to safe drinking water. | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| c Analyze the environmental impact of AQUA CUBE | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| d Decide how to disclose the way of setting prices for the purified drinking water and the water quality of it. | | | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| e Decide how to sell the purified drinking water. | ■ | | | | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| f Submit the proposal to Sagay City for the water supply system with AQUA CUBE at other barangays near Barangay Baviera and Barangay Colona Divina. | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| g Sell the purified drinking water at the affordable price to people. At the same time, collaborate with Sagay City to adopt the security measures to protect purified water and AQUA CUBE. (Demonstration and verification of AQUA CUBE in two sites) | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| h Analyze the quality of intake water for purification and treated water by AQUA CUBE and assess the outcome of the result of purification objectively. | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Counterpart Training | | | | | | | | | | | | | | | | | | | | |
| a For appropriate operation and maintenance by Sagay City after the Survey, offer the capacity building assistance to Sagay City on the series of operation and maintenance, such as the way of selecting and the quality of raw water appropriate for purification by AQUA CUBE, performance management with numerical index of the water purification business, and so on. Organize the way of purification water and sales areas after the Survey with Sagay City. | ■ | | | | ■ | | | | | | | ■ | | | ■ | | | | | |
| b Receive appropriate counterpart personnel in Japan for their learning the equipment and the system of AQUA CUBE as well as water supply technologies and systems of Japan. | | | | ■ | | | | | | | | | | | | | | | | |
| Establishment of the system at the time of disaster | | | | | | | | | | | | | | | | | | | | |
| a Establish the water supply system at the time of disaster to ensure the supply of drinking water with AQUA CUBE with collaboration of Sagay City and related entities. | ■ | | | | ■ | | | | | | | ■ | | | ■ | | | | | |
| b Simulate the emergency cases and verify the procedures and capacity of Sagay City to supply drinking water urgency at a pilot site in Sagay City. | ■ | | | | ■ | | | | | | | ■ | | | ■ | | | | | |
| (2) Dissemination of AQUA CUBE | | | | | | | | | | | | | | | | | | | | |
| a Make a comparison of the costs between AQUA CUBE and other watery supply ways such as water supply by water tank truck, replacement of deteriorated water pipelines and laying new water pipelines. | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| b Conduct dissemination activities such as workshops to appeal the advantages of AQUA CUBE for Negros Occidental provincial government, Sagay City Water District, the neighboring residents based on the results of drinking water supply business conducted by Sagay City. | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| c Investigate the laws and regulations about water supply and raw water of other local governments and conduct hearings about water supply with other local governments. | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| d Conduct dissemination activities such as workshops to appeal the advantages of AQUA CUBE for the local government and water suppliers which are most likely to purchase. | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| (3) Formulation of the plan to disseminate AQUA CUBE | | | | | | | | | | | | | | | | | | | | |
| Formulate the plan further to disseminate AQUA CUBE in Sagay City and other areas after the Survey. | | | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ |
| Deliverables | | | | | | | | | | | | | | | | | | | | |
| a Progress report | | | | | | | | ▲ | | | | | | | ▲ | | | | | |
| b Final report (draft) | | | | | | | | | | | | | | | | | | ▲ | | |
| c Final report | | | | | | | | | | | | | | | | | | | ▲ | |

Activity in Japan ■
Activity in Philippine ■

(8) Manning Schedule

Table 2: Manning Schedule

| Responsibilities | Members | Affiliation | 2015 | | | | | | | | | | | | 2016 | | | | | | | | Man/Month | | | |
|--|-------------------|----------------------------------|------|---|---|---|---|---|---|---|---|----|----|----|------|---|---|---|---|---|---|---|-------------|-------|-------|------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Philippines | Japan | | |
| (Chief) Manage and organize the overall Survey. | Inada Satoru | INADA Inc. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 0.83 | 2.25 |
| (Vice chief) Lead the field survey. | Omori Yasuhiro | INADA Inc. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 2.57 | 4.80 |
| Conduct field survey and support preparation of final report. | Inada Koichi | INADA Inc. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 1.37 | 3.25 |
| Conduct survey related to local assembling of AQUA CUBE. | Inada Ichiro | INADA Inc. | | | | | | | | | | | | | | | | | | | | | | | 0.20 | 1.00 |
| Manage daily operations. | Ishihara Noriko | INADA Inc. | | | | | | | | | | | | | | | | | | | | | | | 0 | 3.00 |
| Assist in operation of AQUA CUBE and conduct counterpart training. | Shirai Tomohiro | Murakami Manufacturing CO., LTD. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 0.87 | 2.85 |
| Design AQUA CUBE and conduct counterpart training. | Takahashi Tsutomu | Murakami Manufacturing CO., LTD. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 0.67 | 1.85 |
| (Chief consultant) Provide technical assistance for design and installation of AQUA CUBE. Design water supply scheme for emergencies using AQUA CUBE. | Sumiyama Makoto | Tepia Corporation Japan CO., LTD | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 0.67 | 1.75 |
| Provide technical consultation on water quality & facility management. | Hu Junjie | Tepia Corporation Japan CO., LTD | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 0 | 1.30 |
| Conduct financial analysis. | Sakano Momoko | Tepia Corporation Japan CO., LTD | | | | | | | | | | | | | | | | | | | | | | | 0 | 1.30 |
| Prepare water supply business model. Conduct seminars for local governments. Prepare dissemination scheme. | Kinouchi Ryota | Tepia Corporation Japan CO., LTD | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 2.30 | 1.55 |
| Verify O&M of the water supply business. Conduct seminars for local residents. Collect fundamental data and information through field survey. Summarize the final report in English. | Bajracharya Ashok | Tepia Corporation Japan CO., LTD | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 2.07 | 1.55 |
| Proponent | | | | | | | | | | | | | | | | | | | | | | | Man/Month | 4.97 | 14.30 | |
| External Personnel | | | | | | | | | | | | | | | | | | | | | | | Man/Month | 5.04 | 7.45 | |
| Technical support | | | | | | | | | | | | | | | | | | | | | | | Man/Month | 1.54 | 4.70 | |
| Total | | | | | | | | | | | | | | | | | | | | | | | Man/Month | 11.55 | 26.45 | |
|  | | | | | | | | | | | | | | | | | | | | | | | | | | |

(9) Implementation System

The implementation scheme is illustrated in the figure below. This survey was executed by INADA Inc. under JICA supervision and cooperation from Murakami Manufacturing Co. Ltd. and Tepia Corporation Japan Co. Ltd.

The responsibilities of each organization are as follows.

INADA Inc. is in charge of;

- ① Leading the overall Survey.
- ② Supervising water supply business by Sagay City.
- ③ Introducing Aqua Cube to neighboring local government units.
- ④ Investigating the options and possibility of local manufacturing.
- ⑤ Bridging the local and Japanese entities.
- ⑥ Preparing survey reports.

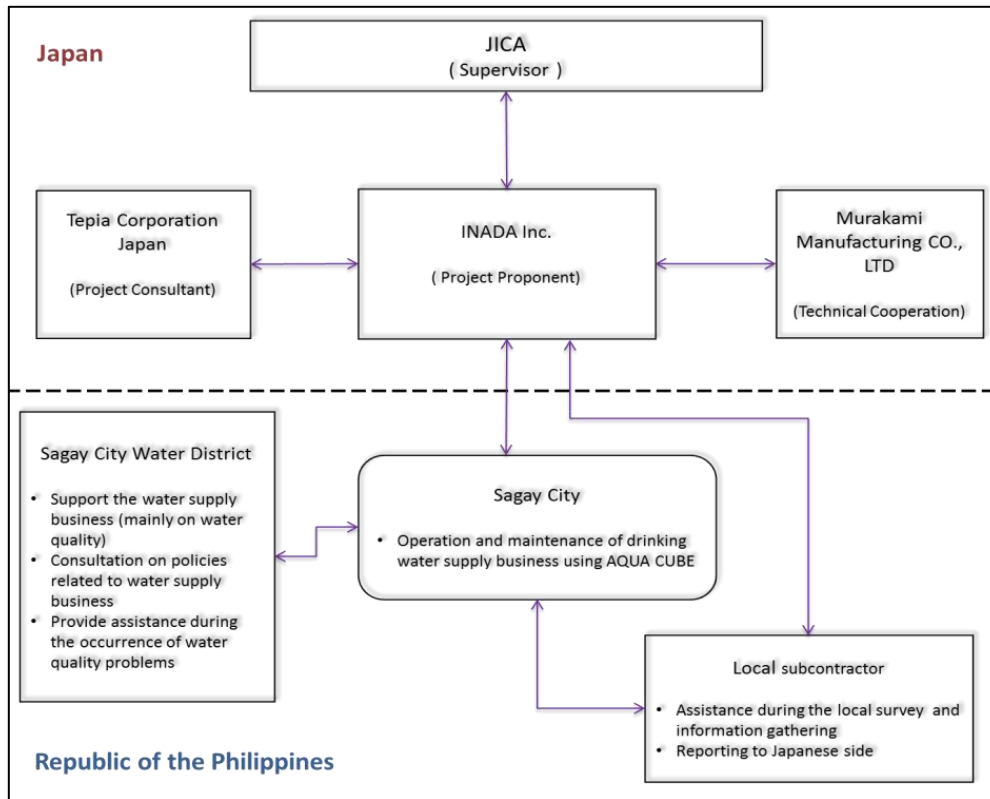
Murakami Manufacturing CO., LTD. is in charge of;

- ① Designing, manufacturing and installing of Aqua Cube in the sites.
- ② Providing technical advice on the Product for Sagay City and INADA Inc.
- ③ Training the counterpart in Japan.

Tepia Corporation Japan CO., LTD. is in charge of;

- ① Supporting INADA Inc. in research planning and implementation of the survey.
- ② Providing technical assistance related to the water sector.
- ③ Formulating dissemination plans with INADA Inc.

Figure 2: Implementation Structure of the Survey



3. DETAILS OF ACTIVITIES

Activity 1: Preliminary survey, manufacturing, and shipping of AQUA CUBE, drafting of operation manual.

a) Preliminary survey

The survey team conducted the site survey to check the water sources and the proposed site for AQUA CUBE installation in both barangays.

Raw water intake points and their distance from the AQUA CUBE installation site were checked. Pack Test was conducted to check the water quality of raw water. The survey team also collected samples of raw water from both water sources and had have them analyzed at DOH accredited laboratory “W.J. Villanueva Inc.”.

Regarding the land usage at the proposed site, Sagay City had agreements with the land owners such that Sagay City is permitted to use the land for the water distribution project.

b) Manufacturing and shipping of AQUA CUBE

Murakami manufacturing Co. Ltd. manufactured two AQUA CUBEs. Based on the result of the preliminary survey, few modifications as below were made in the AQUA CUBEs.

- i. Installed switching system to choose power source from either commercial power supply (single phase 220V) or built-in generator as per request from Sagay City.
- ii. A multilingual user interface was programmed in the control panel.
- iii. High-pressure faucet output was added for the purpose of cleaning the water containers.
- iv. Stainless steel work table of appropriate size and height with multiple faucets were built to facilitate water refilling in the containers.



Picture: AQUA CUBEs being manufactured

After the completion of manufacturing process, both AQUA CUBEs were shipped to Sagay City on April 28th, 2015 via Cebu port. The cargo arrived in Bacolod on May 23rd, 2015 and then transported to Sagay City on a truck.

AQUA CUBE was installed in barangay Baviera on May 25th, 2015, and in Colonia Divina on May 27th, 2015. Sagay City also built fences around the AQUA CUBEs in both barangays for their protection.



Picture: Installation of AQUA CUBE in Baviera (May 25th, 2015)



Picture: Installation of AQUA CUBE in Colonia Divina (May 27th, 2015)

c) Preparation of operation manual

The manual for operation and maintenance, and troubleshooting of the AQUA CUBEs were compiled. These manuals were also translated into English and submitted to Sagay City.

Activity 2: Demonstration and verification of AQUA CUBE

a) Analyze operation and maintenance cost

The survey team analyzed the cost for operation and maintenance of AQUA CUBE based on the following pre-set operating condition.

Table 3: Operating conditions for AQUA CUBE

| Operating Condition | |
|--|----------------------|
| Business hours | 8 hours/day |
| Running hours of AQUA CUBE | 4 hours/day |
| Annual business days | 300 days |
| Annual production of purified water | 2,400 m ³ |
| Annual volume of water sold (assuming 10% of total production will be used to clean water containers.) | 2,160m ³ |

| Particulars | Annual cost | Remarks |
|---------------------------------------|------------------------|---|
| NWRB permit for using water source | 5,000 PHP ³ | <ul style="list-style-type: none"> • National Water Resource Board, Water Code of the Philippines (the “Water Code”) • Hearing result from Sagay City Water District. |
| Personnel expenses | 76,950 PHP | <ul style="list-style-type: none"> • Assuming one operation staff • Annual working days: 300 days • Minimum daily wage of Western Visayas Region (non-agricultural sector): 256.5 PHP per day per person |
| Activated carbon filter | 13,226 PHP | <ul style="list-style-type: none"> • Cost in Japan • Assuming consumption of 6 filters per year (i.e. changing the filter every 2 month) |
| Electricity (commercial power supply) | 32,143 PHP (Tax excl.) | • Assumed unit price of electricity: 10 PHP/kWh (Tax incl.) |
| Chlorine | 2,940 PHP (Tax excl.) | • Cost in Japan (1,000JPY/L ⁴ =367.4 PHP/L) |
| Water quality analysis | 5,357 PHP (Tax excl.) | <ul style="list-style-type: none"> • Bactological test (every month) • Physical chemical test (every six month) |
| Total (Tax excl.) | 135,616 PHP | |

If the caps and faucets (in slim type container) of containers are sealed after refilling, additional cost for caps and seals will be 62,598 PHP (Tax excl.) and shall be added to the total annual operation cost above. In Baviera, sealing was started from December 2015.

³ PHP: Philippine Peso

⁴ JPY: Japanese Yen; L: liter(s)

During this survey, delivery of water containers was not conducted. However, from the result of this survey, it was clear that delivery service of water containers is very important to increase the sales volume and to supply potable water to the residents who live far from the AQUA CUBE installation site. Therefore, to analyze the operating cost with delivery service, personnel expenses of 76,950 PHP/year and gasoline cost of 11,719 PHP/year for delivery bike/vehicle were added. In other words, an additional cost of total 88,669 PHP/year is required to implement the delivery service.

b) Survey on market price of purified water and residents' willingness to pay for potable water.

Refilled water containers (20L) are sold at 45 to 50 PHP in sari-sari stores of the barangays. The survey team conducted a questionnaire survey to investigate the residents' willingness to pay for potable water in both barangays. The result of the survey shows that most of the residents are willing to pay from 10 to 20 PHP per container.

Based on this result and upon discussion with Sagay city, the selling price of potable water from AQUA CUBE was set at 15 PHP per 20L which is more than one-third cheaper than the market price.

c) Verification of operation of AQUA CUBE in two barangays

After the installation of AQUA CUBE, the survey team along with the barangay operation staffs and members from Sagay City conducted test operations to confirm that they function properly in both barangays. Before distributing water to the residents, samples of purified water were analyzed at W.J. Villanueva Inc. (DOH accredited laboratory) to ensure that the purified water is safe and potable. After it was confirmed that the test results meet the criteria of Philippines National Standards for Drinking Water (PNSDW), distribution of water was launched on June 16th, 2015 under direct supervision of Mayor Maranon.

The survey team checked the necessity of followings permits with Sagay City, and it was confirmed that no such permits are needed for the survey as this project is operated by a public entity (Sagay City).

- Water distributing Permit from LWUA (Local Water Utilities Administration)
- Water Permit from NWRB (National Water Resources Board)

- Sanitary permit from DOH (Department of Health)
- Business permit from DTI (Department of Trade and Industry)

Sagay City also announced that during the survey period, distribution of water to residents will not be considered as a business activity for commercial purposes. However, 15 PHP per 20L shall be collected from residents in the form of donation.

During the survey period, operation staffs from both barangays and Sagay City members regularly monitored the operating situation of AQUA CUBE and water distribution along with daily water quality under the supervision from Japan. Sagay City also prepared monthly reports based on the daily monitoring data and regularly updated to Japan. The survey team from Japan also visited the sites frequently to inspect the operation status. During the site visits, operation staffs, and local residents were interviewed to grasp the situation of the survey.

Many residents including barangay captain, school teachers who live near the AQUA CUBE installation site gradually started to consume purified water regularly. However, there are people who still continue to drink contaminated water from deep well.

Followings points are the possible reasons why many residents did not purchase purified water from AQUA CUBE.

- i. Local residents are not aware that deep well water is contaminated with bacteria. They assumed that clear water without odor is potable.
- ii. People discard garbage in the river and surroundings. There are also people who bathe, wash clothes, and also urinate near the river and irrigation canal. Therefore, people were hesitant to drink water from AQUA CUBE as it uses raw water from the river and the irrigation canal.
- iii. Many residents in both barangays are farmers. They usually do not have work from June to August every year and hence, they have no income. Therefore, only a few residents can afford to purchase purified water during this period.
- iv. It is estimated that only about 10% of total population in each barangay were regularly consuming purified water from AQUA CUBE and most of these residents live near the central areas of the barangays, where AQUA CUBE is installed. This implies that about 90% of the population resides far in the mountain area and it seems to be difficult for them to carry the purified water

containers back to their houses.

To deal with these challenges, suitable actions were also taken as mentioned below.

- Conducted regular workshops to raise awareness of the local residents on clean and safe drinking water and sanitary measures for cleanliness of surroundings.
- Started sealing the caps and faucets of containers after refilling purified water to endorse the safety of water (in barangay Baviera).
- Introduced smaller containers (3L and 10L) to distribute purified water.
- Distributed water containers for free to low-income households.

d) Analysis of environmental impact of AQUA CUBE

There were concerns of reduction of water volume in downstream of the river due to the intake of raw water for AQUA CUBE. However, even if AQUA CUBE is operated for 8 hours per day, the maximum volume of water intake shall be limited to 16 cubic metres and hence it was confirmed that there is no adverse effect on the volume of water in the downstream, even during dry seasons. Moreover, AQUA CUBE does not contain or use any harmful chemicals. So, there is no adverse effect on the environment of the vicinity due to waste water from AQUA CUBE.

e) Distribution of potable water to neighboring barangays

Distribution of water to neighboring barangays is necessary to raise the sales volume of water. During the survey, it also became clear that a majority of people resides far from the central area of barangay and it is difficult for them to carry the refilled containers back to their houses. Therefore, the survey team from Japan made a proposal to Sagay City to launch delivery service of containers with an extra charge within the barangay and to neighboring barangays. Sagay City will consider this after the survey.

f) Distribution of potable water at affordable price to about 6,000 residents

AQUA CUBEs are installed in Colonia Divina and Baviera to distribute potable water at a reduced price to about 6,000 residents in total.

A portion of the population living in the central area of each barangay started to consume water from AQUA CUBE regularly. However, many residents who live far from the installation sites could not take the benefit of AQUA CUBE due to

difficulties in carrying refilled water containers back to their houses.

To resolve it, Sagay City has been considering launching delivery service with an additional charge after the survey period. Moreover, regular workshops and advocacy programs are being conducted for the awareness of the residents. This kind of continuous effort by Sagay City will encourage more residents to consume portable water from AQUA CUBE in a long term.

g) Analysis of water quality and methods to notify the results to the residents

The sources of raw water in Colonia Divina and Baviera are irrigation canal and river respectively. Simple water quality tests (Pack Test) were conducted on the raw water in both barangays. Physical & Chemical tests were also conducted on raw water at W.J. Villanueva Inc. Based on the results, it was confirmed that the raw water can be purified by AQUA CUBE.

Simple water quality tests (Pack Test) were daily conducted on purified water to check its potability. On the top of that, the purified water samples were regularly analyzed at W.J. Villanueva Inc. These test results are displayed at the water distribution site for public knowledge and the Sagay City Sanitation Inspector explained the results to the residents during workshops that were regularly conducted in each barangay.



Picture: Publication of water quality analysis reports

Activity 3: Counterpart training and formulation of suitable O&M scheme

a) Counterpart training

From April 8th to 21st 2015, the following 4 members were invited to Japan for training on operation and maintenance of AQUA CUBE.

| | Name | Affiliation | Responsibilities |
|---|------------------------|---------------------|-------------------------------------|
| 1 | Benson Fernandez (Mr.) | Sagay City | Administration and Training Officer |
| 2 | Jezreel Alingco (Mr.) | Sagay City | City Engineer |
| 3 | A. Membela (Mr.) | Local subcontractor | Coordinator |
| 4 | R. Hingvillo (Mr.) | Local subcontractor | Technician |

Main contents of the counterpart training were as follows.

- i. Structural details and assembled parts of AQUA CUBE.
- ii. Operating procedure.
- iii. Troubleshooting methods.
- iv. Differences of potable water and contaminated water.
- v. Water supply systems in Japan.
- vi. Installing, transporting and operating AQUA CUBE during emergencies.

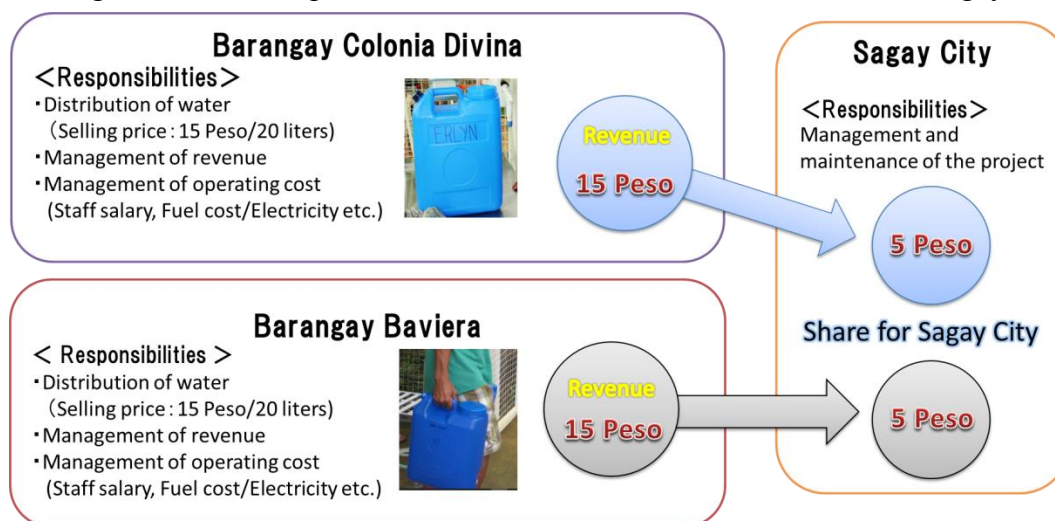
b) Formulation of suitable O&M scheme

For proper operation and maintenance, the members who were trained in Japan, instructed the operation staffs and engineers in both barangays and in Sagay City.

Moreover, in order to formulate sustainable management system, responsibilities regarding operation and maintenance were divided among Sagay City and each barangay from September 2015. Each barangay became responsible for the operation of water distribution. They will also bear the operation cost such as personnel expenses, electricity or gasoline expenses. On the other hand, Sagay City will be mainly responsible for maintenance and overall management of the project.

As for this, Sagay City and each barangay mutually agreed that the revenue shall also be divided among each barangay and Sagay City. Each barangay will receive 10 PHP and Sagay City will receive 5 PHP for every container sold. (15 PHP/L is the selling price of each container.) (See Figure 3)

Figure 3: O&M responsibilities for distribution of water in each barangay



Activity 4: Formulation of water supply scheme during occurrence of disaster using
AQUA CUBE

Sagay City conducted drills to simulate water distribution using AQUA CUBE during disaster. The disaster drills were successful to estimate time and personnel requirements for transportation of AQUA CUBE. The Sagay City members consisting of rescue team were successful in noticing many unexpected troubles. They also came up with necessary measures including troubleshooting methods for smooth and safe execution of water distribution during such emergencies. Moreover, potential raw water sources were also identified.

2 AQUA CUBES were added in Sagay City’s list of equipment that is to be used during disaster. In addition, water distribution using AQUA CUBE was also added in Disaster Preparedness and Response Protocol for Sagay City, LDRRM and the City Mayor has already approved it.

Similarly, the procedure for decision making for dispatch of AQUA CUBE to disaster affected area was also determined. According to Sagay City, this shall be made on the basis of Damage Assessment and Need Analysis (DANA) by Disaster Risk Reduction and Management Council (DRRMC).

Activity 5: Dissemination of AQUA CUBE

a) Cost comparison of AQUA CUBE

According to Sagay City Water District (SCWD), spring water has been identified

in the mountain area that can be used as source water for Divina Colonia, Campo Sanitago, Baviera and other barangays. Based on the hearing from SCWD, the calculation of total cost merely for laying down water pipes from the water source to barangay Colonia Divina and to barangay Baviera was approximately 5.4 million PHP (15 million yen) and 6.6 million PHP (18.4 million yen) respectively. Comparing these costs, installing AQUA CUBE seems to be much less expensive and more effective.

Similarly, AQUA CUBE was also compared with other water purification methods such as Reverse Osmosis and Sand filtration (see Figure 4), based on the particulars in the table below (Table 4).

Figure 4: Comparison of water purification methods

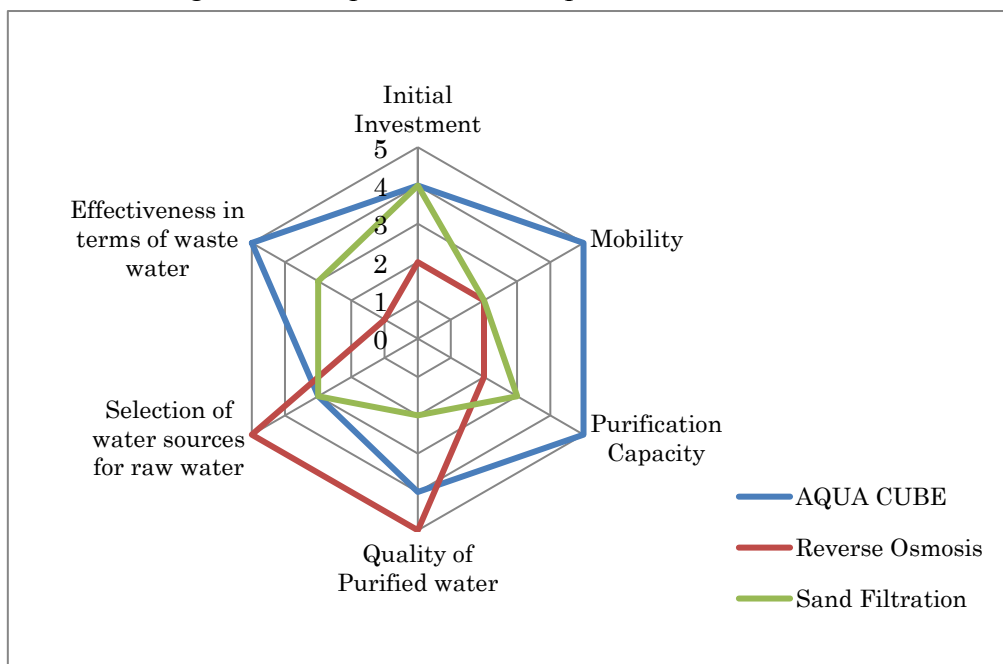


Table 4: Criteria for rating the methods of water purification

| Rating | 5 | 4 | 3 | 2 | 1 |
|---|---------------------------------------|------------------|-------------------------------------|---------------------------------------|-------------------------|
| Initial Investment (only for Purification unit) | < 5 million yen | < 10 million yen | < 30 million yen | < 50 million yen | < 100 million yen |
| Mobility | Highly mobile and specially designed. | Can be moved. | Can be moved after few adjustments. | Need a lot of adjustments for moving. | Immovable / Fixed type. |

| | | | | | |
|--|--|--|---|--|------------------------------|
| Purification Capacity | > 1000L/h | > 500L/h | > 300L/h | > 100L/h | < 100L/h |
| Quality of purified water | Can remove all impurities. | Can completely remove E.coli, Bacteria. | Can remove only some bacteria. | Cannot remove bacteria. | Cannot remove the turbidity. |
| Selection of water sources for raw water | It can purify all kind of raw water. (including sea water) | Limitation in choosing raw water. It can purify river and deep well water. | Limitation in choosing raw water. It can purify water from selected rivers and deep well. | Severe limitation in choosing raw water. It cannot purify river water. | Can only purify tap water. |
| Effectiveness in terms of waste water | > 95% | > 80% | > 50% | > 30% | < 30% |

This comparison demonstrates the superiority and advantages of AQUA CUBE over other purification methods.

These advantages were discussed and explained to Sagay City and Provincial government for their understanding.

b) Financial analysis on water supply business with AQUA CUBE

During this survey, delivery service was not provided. However, delivery service is necessary to distribute water to residents who live far from the central area of each barangay and to neighboring barangays. Therefore, this financial analysis is conducted in two methods.

- i.e. With delivery service of water containers and without delivery services of water containers.

Here, financial analysis on water supply business with AQUA CUBE is conducted for both private and public entities.

i. Private entities

Financial analysis of water supply business with AQUA CUBE is conducted in terms of IRR (Internal Rate of Return) based on the following pre-set parameters.

Table 5: Pre-set parameters for financial analysis

| Parameters | Cost | Remarks |
|---|------------------|--|
| Number of installed AQUA CUBE | 1 unit | Purification capacity 2000 L/h |
| Installation period | 3 months | |
| Project period | 10 years | Same as depreciation period |
| Exchange rate | 2.722 yen/PHP | |
| Initial Investment (Tax excl.) | 3,902,790 PHP | Without delivery service |
| | 4,043,415 PHP | With delivery service |
| • Expenses in Japan | | |
| Cost of AQUA CUBE ⁵ | (8,400,000 yen) | CIF value from Japan to Cebu. |
| | 3,085,966 PHP | |
| • Expenses in Philippines | | |
| Transportation cost (Tax excl.) | 44,643 PHP | Based on the figures obtained in this survey. |
| Purchase of vehicle for delivery of water containers (Tax excl.) | 133,929 PHP | Cost of 1 unit of vehicle or motorbike |
| Custom duty | 586,334 PHP | 19 % |
| Liquid capital (5% of static investment) | 185,847 PHP | Without delivery service |
| | 192,544 PHP | With delivery service |
| Depreciation | 293,902 PHP/year | Assuming depreciation of water purification equipment only |
| Depreciation period | 10 years | |
| • O&M Cost (Tax excl.) | 181,745 PHP/year | Without delivery service |
| | 258,695 PHP/year | With delivery service |
| Water permit | 5,000 PHP/year | |
| Personnel cost | 76,950 PHP/year | Without delivery service (assuming 1 operation staff) |
| | 153,900 PHP/year | With delivery service (assuming 1 operation staff and 1 delivery staff) |
| Activated carbon | 4,409 PHP/year | |

⁵ Note: It is based on manufacturing cost of the main body of AQ07 type AQUA CUBE in Japan. Selling cost might differ due to variation in exchange rates and customization of parts and equipment.

| | | |
|--|----------------------|---|
| Electricity | 16,071 PHP/ year | |
| Gasoline | 11,719 PHP/ year | Estimated only for delivery bike/vehicle. |
| Chlorine | 2,936 PHP/ year | |
| Water quality Analysis fee | 5,357 PHP/ year | |
| Cap and Sealing | 59,304 PHP/ year | Including round type and slim type containers (1:1) |
| Exchange of MF filter | 551,065 PHP | Once every 5 years |
| Cost of MF membrane | 367,377 PHP | Estimated at 1 million Yen |
| Exchanging fee | 183,688 PHP | Estimated at 500,000 Yen. |
| Revenue (Tax excl.) | | |
| Selling price of water | 0.67 PHP/L | Assuming 15 PHP per 20L |
| | 1.12 PHP/L | Assuming 25 PHP per 20 L. (Assuming 10 PHP delivery charges per container.) |
| Taxation | | |
| VAT | 12% | |
| Corporate tax | 0% | Public entity |
| | 30% | Private entity |
| Operating conditions | | |
| Target population for water supply | Approx. 2,500 people | |
| Purification capacity | 2,000 L/h | |
| Business hours | 8 hours / day | |
| Operating hours of AQUA CUBE | 4 hours / day | |
| Annual business days | 300 days | |
| Annual volume of water production | 2,400 m ³ | |
| Annual volume of water sold (assuming 10% of water loss due to cleaning of containers) | 2,160 m ³ | |
| Percentage of volume of water assumed to be distributed | 50% | |

From this analysis result, IRR for each case is shown in the following table.

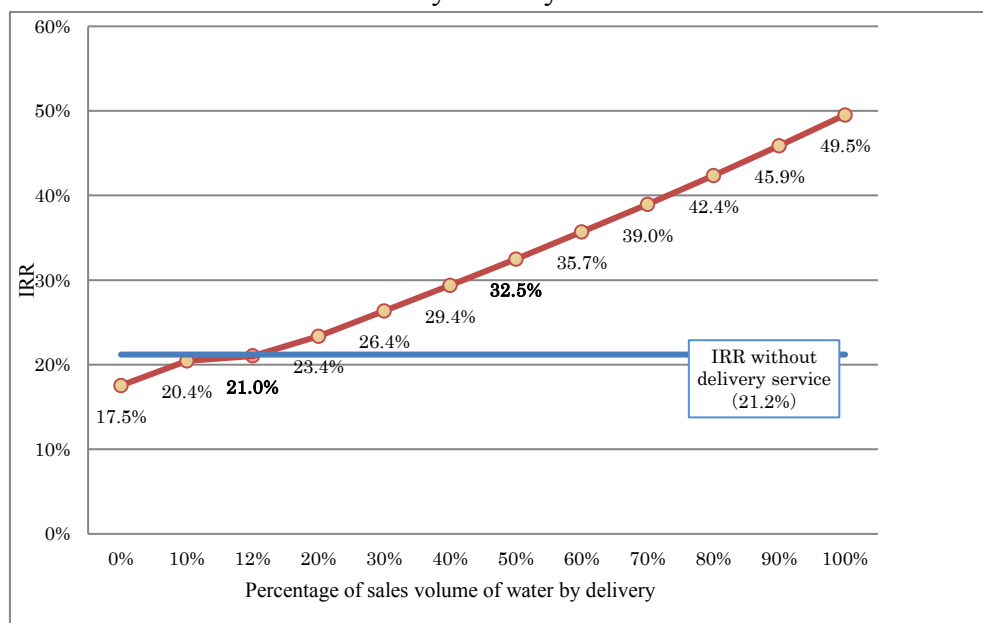
Table 6: Result of financial analysis for Private entity

| | IRR | Payback period |
|--------------------------|-------|----------------|
| Without delivery service | 21.2% | 3.7 years |
| With delivery service | 32.5% | 2.8 years |

With delivery service, the IRR is higher than that of without delivery service. Similarly, the payback period is shortened by approximately 1 year in the water supply business with delivery service.

The above analysis results also show that higher the percentage of the volume of water sold by delivery, the higher IRR will be, which is represented by the following figure.

Figure 5: Shift of IRR along with the change in percentage of volume of water sold by delivery



However, if the percentage of the volume of water sold by delivery falls below 12%, IRR becomes lower than that of the water supply business without delivery service. Hence, this point should be noted when launching water supply business with delivery service.

Following tables represent the analysis details.

Table 7: Financial analysis of water supply business without delivery service for Private entities.

| Financial analysis | | AQUA CUBE AQ07 TYPE | | | | | | | | | | |
|---|------------|---------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|
| Year | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Load Factor | | 75% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 25% |
| A. Revenue | | | | | | | | | | | | |
| a) Water supply revenue | | | | | | | | | | | | |
| Net water supply (m ³ /v) | 2.160 | 1.620 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 540 |
| Water tariff (PHP/L, Exc. VAT) | 0.67 | 1,084.821 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 361.607 |
| b) Others | | | | | | | | | | | | |
| - Recovery of current capital | | | | | | | | | | | | |
| - Fixed asset residue | | | | | | | | | | | | |
| Total Revenue | | 1,084.821 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 361.607 |
| B. Cash out | | | | | | | | | | | | |
| a) Investment | | | | | | | | | | | | |
| - Static investment | 3,716,943 | 3,902,790 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - Current capital (5% of static investment) | 185,847 | 3,716,943 | | | | | | | | | | |
| b) O&M cost | | | | | | | | | | | | |
| - O&M cost | 181,745 | 136,309 | 181,745 | 181,745 | 181,745 | 181,745 | 181,745 | 181,745 | 181,745 | 181,745 | 181,745 | 45,436 |
| c) Inspection cost | | | | | | | | | | | | |
| - Inspection cost | 551,065 | | | | | | 551,065 | | | | | |
| d) Tax | | | | | | | | | | | | |
| VAT | | 43,893 | 454,238 | 454,238 | 454,238 | 454,238 | 288,918 | 454,238 | 454,238 | 454,238 | 454,238 | 105,633 |
| - VAT for selling | 12% | 130,179 | 173,571 | 173,571 | 173,571 | 173,571 | 173,571 | 173,571 | 173,571 | 173,571 | 173,571 | 43,393 |
| - VAT for buying | 12% | 86,286 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 | 10,569 |
| Income tax | 30% | - | 291,235 | 291,235 | 291,235 | 291,235 | 125,915 | 291,235 | 291,235 | 291,235 | 291,235 | 72,809 |
| - Depreciation | 293,902 | 220,426 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 73,475 |
| Total Cash Out | | 4,082,992 | 635,983 | 635,983 | 635,983 | 635,983 | 1,021,729 | 635,983 | 635,983 | 635,983 | 635,983 | 151,069 |
| Net Profit | | (3,174,704) | 970,782 | 970,782 | 970,782 | 970,782 | 419,716 | 970,782 | 970,782 | 970,782 | 970,782 | 242,695 |
| C. Cashflow | | | | | | | | | | | | |
| Cashflow | | (2,998,170) | 810,445 | 810,445 | 810,445 | 810,445 | 424,700 | 810,445 | 810,445 | 810,445 | 810,445 | 210,538 |
| Cumulative | | (2,998,170) | (2,187,725) | (1,377,280) | (566,835) | 243,610 | 668,310 | 1,478,755 | 2,289,200 | 3,099,645 | 3,910,090 | 4,120,628 |
| Payback period | 3.69 Years | | | | | | | | | | | |
| IRR | 21.2% | | | | | | | | | | | |

Table 8: Financial analysis of water supply business with delivery service for Private entities.

| Financial analysis | | AQUA CUBE AQ07 TYPE | | | | | | | | | | |
|--|------------|---------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|----------------|
| Year | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Load Factor | | 75% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 25% |
| A. Revenue | | | | | | | | | | | | |
| a) Water supply revenue | | | | | | | | | | | | |
| Net water supply (m ³ /v) | 2.160 | 1.620 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 2.160 | 540 |
| Water tariff (PHP/L, Exc. VAT) | 0.67 | 1,084.821 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 1,446.429 | 361.607 |
| Water tariff with delivery (PHP/L, Exc. VAT) | 1.12 | | | | | | | | | | | |
| Water tariff (delivery of water) | | 1,446.429 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 1,928.571 | 482.143 |
| b) Others | | | | | | | | | | | | |
| - Recovery of current capital | | | | | | | | | | | | |
| - Fixed asset residue | | | | | | | | | | | | |
| Total Revenue (Assuming 50% of water) | | 1,446,429 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 1,928,571 | 482,143 |
| B. Cash out | | | | | | | | | | | | |
| a) Investment | | | | | | | | | | | | |
| - Static investment | 3,850,871 | 4,043,415 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| - Current capital (5% of static investment) | 192,544 | 3,850,871 | | | | | | | | | | |
| b) O&M cost | | | | | | | | | | | | |
| - O&M cost | 258,695 | 194,022 | 258,695 | 258,695 | 258,695 | 258,695 | 258,695 | 258,695 | 258,695 | 258,695 | 258,695 | 64,674 |
| c) Inspection cost | | | | | | | | | | | | |
| - Inspection cost | 551,065 | | | | | | 551,065 | | | | | |
| d) Tax | | | | | | | | | | | | |
| VAT | | 69,808 | 632,247 | 632,247 | 632,247 | 632,247 | 466,927 | 632,247 | 632,247 | 632,247 | 632,247 | 149,081 |
| - VAT for selling | 12% | 173,571.43 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 231,428.57 | 57,857.14 |
| - VAT for buying | 12% | 103,764 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 | 11,975 |
| Income tax | 30% | - | 412,793 | 412,793 | 412,793 | 412,793 | 247,473 | 412,793 | 412,793 | 412,793 | 412,793 | 103,199 |
| - Depreciation | 293,902 | 220,426 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 293,902 | 73,475 |
| Total Cash Out | | 4,307,244 | 890,942 | 890,942 | 890,942 | 890,942 | 1,276,688 | 890,942 | 890,942 | 890,942 | 890,942 | 213,755 |
| Net Profit | | (3,011,434) | 1,375,974 | 1,375,974 | 1,375,974 | 1,375,974 | 824,909 | 1,375,974 | 1,375,974 | 1,375,974 | 1,375,974 | 343,994 |
| C. Cashflow | | | | | | | | | | | | |
| Cashflow | | (2,860,816) | 1,037,629 | 1,037,629 | 1,037,629 | 1,037,629 | 651,884 | 1,037,629 | 1,037,629 | 1,037,629 | 1,037,629 | 268,388 |
| Cumulative | | (2,860,816) | (1,823,187) | (785,558) | 252,071 | 1,289,700 | 1,941,583 | 2,979,212 | 4,016,841 | 5,054,470 | 6,092,099 | 6,360,487 |
| Payback period | 2.75 Years | | | | | | | | | | | |
| IRR | 32.5% | | | | | | | | | | | |

ii. Public entities

Public entities like LGUs install water purification equipment as a part of infrastructure development using government budgets. Therefore, the initial investment is less important to be considered in this financial analysis. However a sustainable operation becomes important and the project should be successful enough to cover the operation and maintenance cost. At the same time, LGUs also might want to check the marginal selling price so that it can sell the water at the least possible price targeting the low-income residents.

Therefore, each parameter for operation is derived in a daily basis and profit from daily operation is also calculated for both cases. i.e. with delivery service and without delivery service.

The following table shows the calculation of daily profit value.

Table 9: Calculation of daily profit

| Production of Water | | |
|--|-----------------|---|
| Production capacity | 2,000L per hour | |
| Business hours | 8 hours | |
| Operating hours | 4 hours | |
| Volume of water produced daily | 8,000 L | |
| Waste water | 10% | Assuming 10% of water used for cleaning the containers. |
| Volume of water that can be sold | 7,200 L | |
| Number of containers that can be sold (20 L containers) | 360 containers | |
| O&M cost | | |
| Total daily O&M Cost | 566.76 PHP/day | Without delivery service |
| | 862.32 PHP/day | With delivery service |
| Water permit | 16.67 PHP/day | |
| Staff wages | Operation staff | 256.50 PHP/day |
| | Delivery staff | 256.50 PHP/day |
| Activated carbon filter | 14.70 PHP/day | |
| Electricity charges | 53.57 PHP/day | |
| Gasoline expenses for delivery vehicle | 39.06 PHP/day | For delivery bike/vehicle |
| Chlorine | 9.79 PHP/day | |

| | | |
|--|------------------|--|
| Cap and sealing | 197.68 PHP/day | |
| Water quality analysis | 17.86 PHP/day | |
| Revenue | | |
| Selling price of water (Without delivery service) | 0.67 PHP/L | 15 PHP per 20L |
| Selling price of water (With delivery service) | 1.12 PHP/L | Assuming 10 PHP shall be charged as delivery fee per container. (15 + 10 PHP/ 20L) |
| Percentage of volume of water sold by delivery | 50% | Assumption |
| Revenue | 4,821.43 PHP/day | Without delivery service |
| | 6,428.57 PHP/day | With delivery service |
| Profit | 4,254.67 PHP/day | Without delivery service |
| | 5,566.25 PHP/day | With delivery service |

Sensitivity analysis of profit based on this calculation shows that O&M cost can be recovered even when the selling price is as low as 10 PHP if at least 65 containers are sold daily in the case of water supply business without delivery service. When the selling price is 20 PHP i.e. similar to market price in Sagay City proper, the daily profit will exceed 3,000 PHP after selling 200 containers per day (see Table 10). This implies that an additional AQUA CUBE can be purchased and installed within 2.7 years by the profit gained from the water supply business.

On the other hand, with delivery service, the O&M cost can be recovered if at least 49 containers are sold daily at selling price of 25 PHP (i.e. assuming delivery service charge of 10 PHP per container added to the selling price of 15 PHP). Even when, the selling price is 10 PHP, i.e. charging only the delivery fee, the marginal number of containers to be sold daily shall be 78 containers (see Table 11).

These analyses prove that water supply business with AQUA CUBE can be highly profitable for both public and private entities.

c) PR activities for AQUA CUBE and its advantages

The survey team in cooperation with Sagay City conducted regular workshops and a number of events to distribute free water to local residents in both barangays for PR of AQUA CUBE and to appeal the safety of purified water. About 150 to 200 residents with a majority of women participated in each workshop.

Main topics of the workshops are as follows.

- Objectives of the survey project
- Methods of water distribution using AQUA CUBE
- Importance of clean and safe drinking water
- Safety of water purified by AQUA CUBE and water quality analysis reports



Picture: Workshop held in Campo Santiago Elementary School (December 2nd, 2015)



Picture: Demonstration of AQUA CUBE in Pana-ad festival (April 15th - 22nd, 2016)

AQUA CUBE was demonstrated in Pana-ad Festival that was held in April 2016 in Bacolod. Every year, LGUs of Negros Occidental Province participate in this festival to conduct PR activities of their products and specialties.

During the Pana-ad festival, a workshop was held for government officials from different LGUs, and Negros Occidental Association of Disaster Risk Reduction Officers and Practitioners (NOADOP) to demonstrate AQUA CUBE. In the workshop, 31 officials from 15 different LGUs participated. In addition, purified water was also distributed for free to about 5,000 visitors during Pana-ad festival to

appeal the potability of purified water.

Features such as “all in one type including power generator”, “mobility”, “sterilization method” etc. were highly admired by the participants. Many media including television channels, newspaper and radio also featured AQUA CUBE.

d) Dissemination of AQUA CUBE in Sagay City and Negros Occidental Province

i. Dissemination of AQUA CUBE in Sagay City

Considering the purification capacity of AQUA CUBE, first, the survey team chose 11 out of 25 barangays with a population of 3,000 people or more. Based on the survey on these 11 barangays, target barangays were shortlisted to 6 barangays. Site surveys and water quality tests were conducted in these barangays and as a result, it was further shortlisted to 3 barangays that have high feasibility of water distribution using AQUA CUBE. The survey results were discussed with Sagay City, and the result on dissemination activities of AQUA CUBE in Sagay City is as follows.

| Barangays | | Survey summary |
|-----------|-----------|---|
| 1 | Molocaboc | It is an island and hence, the only source of water is rainwater. Sagay City is planning to construct a container to collect about 30 cubic metres of rainwater using a roof over the cover court. If enough water can be collected, Sagay City is considering installing customized model of AQUA CUBE (either AQ04 type or AQ00 type). |
| 2 | Vito | Sagay city already identified a suitable site to install AQUA CUBE in Vito. Water supply from SCWD ⁶ shall be used as raw water. The raw water will be collected and stored in a tank which is already installed on the site as a countermeasure of irregular water supply from SCWD. Here, Sagay City is considering a fixed type AQUACUBE AQ04 and price quotation has already been submitted. |

⁶ SCWD: Sagay City Water District

| | | |
|---|---------|--|
| 3 | Paraiso | Paraiso is highly populated barangay and due to the high demand of water, there are many water stations. So, water distribution in reduced price using AQUACUBE may have a negative effect on the existing business groups. Hence, the idea of installing AQUA CUBE in Paraiso is on hold. |
|---|---------|--|

ii. Dissemination of AQUA CUBE in Negros Occidental Province

To identify the LGUs with high feasibility of AQUA CUBE installation, the situation of water supply in each LGU was studied along with the potential water sources available in these LGUs. Potential source of budget for purchasing AQUA CUBE in each LGU was also surveyed.

From this survey, the following 9 LGUs were selected as possible candidates for the dissemination of AQUA CUBE (see Table 12 for the summary of the 9 LGUs). The survey team visited these LGUs in order to approach respective government personnel and water districts, and to conduct water analysis on potential raw water sources in each LGU.

- | |
|---|
| <p>1.Bacolod, 2.Cadiz, 3.Calatrava, 4.Cauayan, 5.Escalante, 6.Himamaylan, 7.Kabankalan, 8.Sipalay, 9.Toboso</p> |
|---|

Surveys were also conducted in schools and hospitals. They also have a high demand for purified water; however, the demand for drinking water in each institution is too low in compare to the capacity of AQUA CUBE.

Table 12: Details of LGUs visited for dissemination activities

| | LGUs | Population (a) | Household (b) | No. of barangay (c) | Income level ⁷ (d) | Main occupation (e) | No. of households with access to water supply (f) | Major sources of water (g) | Market price of purified water (PHP) (per 20L) (h) | NDRRMF (PHP) (i) |
|---|------------|-------------------|------------------|---------------------------|-------------------------------------|---------------------------|---|-------------------------------------|--|------------------------|
| 1 | Bacolod | 511,820 | 81,476 | | 1 | | 46,055 | Deep well | | |
| 2 | Cadiz | 151,500 | 29,715 | 22 | 2 | Agriculture, Factories | 7,337 | Spring, Deep well | 25 | 7,048,363.20 (2016) |
| 3 | Calatrava | 79,009 | 18,905 | 40 | 1 | | 7,985 | Spring | | |
| 4 | Cauayan | 100,412 | 16,735 | 25 | 1 | Agriculture | 0 | Dug well | 20~30 | Approx. 5,000,000 |
| 5 | Escalante | 93,005 | 16,160 | 21 | 4 | | 2,185 | Spring, Deep well | | |
| 6 | Toboso | 41,658 | 8,457 | 9 | 3 | | 6,346 | | | Approx. 4, 760,000 |
| 7 | Himamaylan | 108,099 | 21,620 | 19 | 3 | Agriculture | 4,766 | Deep well | 30 | Approx.20,000,000 |
| 8 | Kabankalan | 167,666 | 35,017 | 32 | 1 | Agriculture, Factories | 4,713 | Spring, Deep well, River | 25~30 | Approx.35,000,000 |
| 9 | Sipalay | 67,345 | 13,772 | 17 | 4 | Tourism, Fishing | 5,741 | Spring, Dug well | 25~30 | |

Source : a,c,d → Philippines Statistics Authority

(<http://www.nscb.gov.ph/activestats/psgc/province.asp?regName=NIR+-+Negros+Island+Region®Code=18&provCode=184500000&provName=NEGROS20OCCIDENTAL>)

b → Municipality Population Data (Negros Occidental) <http://122.54.214.222/population/MunPop.asp?prov=NEC&province=Negros%20Occidental> e, f, g, h,i → Interview results

⁷Income level(d) : 1- High, 4- Low

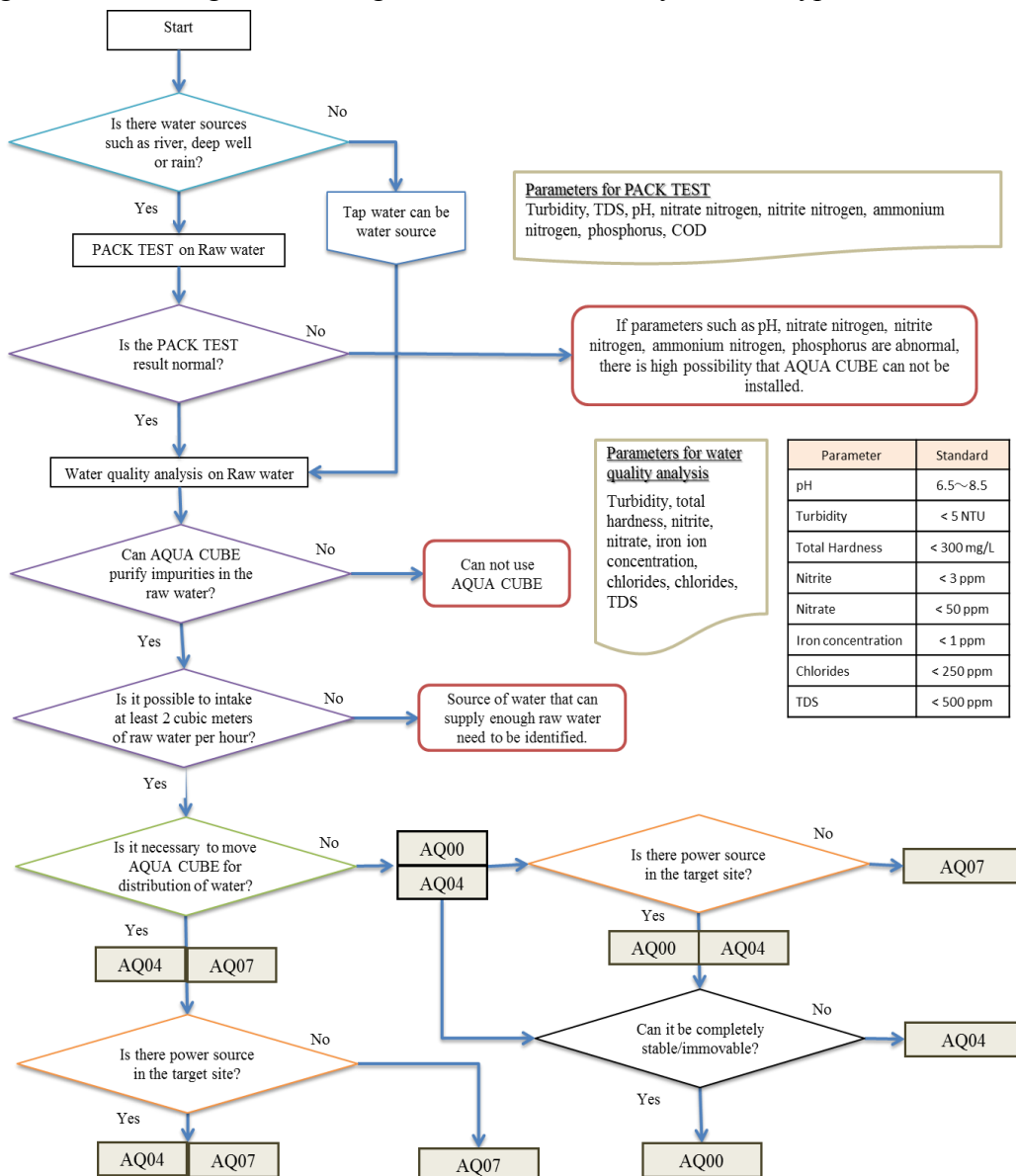
Ministry of Finance Decree 23-08 (Department Order No. 23-08) <<http://nap.psa.gov.ph/activestats/psgc/articles/DepOrderReclass.pdf>>

e) Dissemination method of AQUA CUBE

The operation of AQUA CUBE AQ07 type was demonstrated and verified in this survey. However, it was also understood that there is demand for other types of AQUA CUBE such as AQ04 type and AQ00 type in the Philippines.

Therefore, a suitable type of AQUA CUBE shall be disseminated based on the situation and preliminary survey of the target area to meet its development issues .

Figure 6: Flow diagram showing the method to identify suitable type of AQUA CUBE



4. ACHIEVEMENT OF THE SURVEY

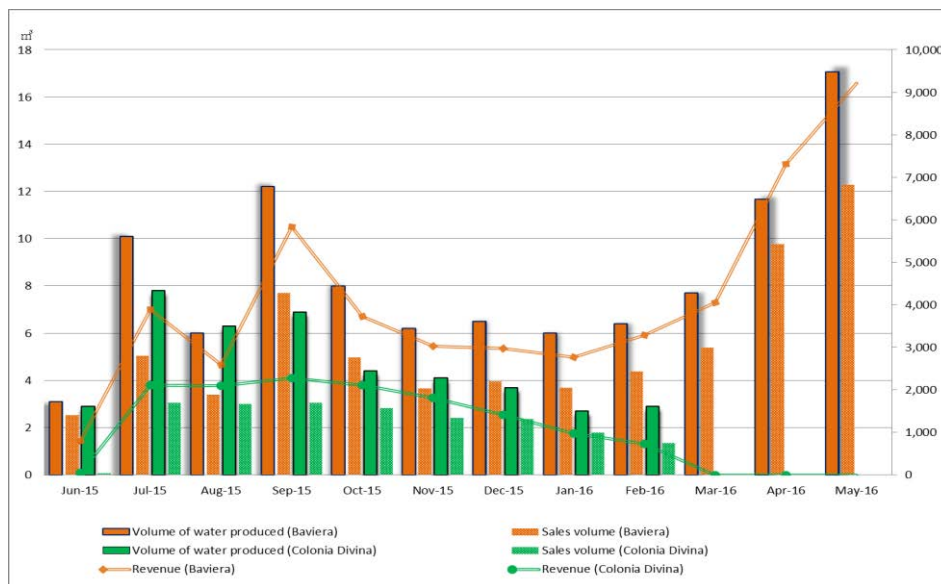
(1) Outputs and Outcomes of the Survey

a) Distribution of potable water to the residents

It was successfully verified that AQUA CUBE functions well in the rural area that has no proper water supply, in order to produce potable water from locally available sources. During this survey, purified water is distributed at a reduced price of 15 PHP per 20L targeting about 6,000 residents in both barangays. Water samples were analyzed regularly at W.J Villanueva Inc. to ensure the potability. Due to consumption of clean and safe drinking water by the residents, diarrhea and other diseases can be reduced in a long run.

Since the majority of residents live in the mountain side and far from the AQUA CUBE installation site, not all the residents could enjoy the benefit of AQUA CUBE. According to the estimates of the survey team, only about 10% of residents were regularly consuming purified water from AQUA CUBE. The sales of purified water in each barangay during this survey period are represented in the figure below.

Figure 7: Monthly shifting of water production volume (m3), sales volume (m3), revenue (PHP)



(Based on the monthly report from Sagay City, until May 2015)

To expand the water distribution, Sagay City is considering delivery service with an additional charge after this survey. With the launch of the delivery service, more

people will be able to purchase purified water from AQUA CUBE at an affordable price.

b) Preparation of water supply scheme using AQUA CUBE during disasters

Sagay City mayor has approved AQUA CUBE as equipment for emergency water supply during disaster and has been added in the Disaster Preparedness and Response Protocol. Sagay City also conducted disaster drills to simulate transportation of AQUA CUBE to an affected area and to distribute water in case of disasters.

c) The superiority of AQUA CUBE over other water purification equipment and results of dissemination activities.

The advantage of installing AQUA CUBE over other kinds of water purification equipments and its financial return are explained in “Activity 5” under “Outline of survey”. As a result of dissemination activities, the LGUs and entities that are highly interested in AQUA CUBE are listed in the table below.

Table 13: Current situation and results of dissemination activities

| | LGUs / entities | Current situation and results of dissemination activities |
|---|---|--|
| 1 | Sagay City | Quotation for AQUA CUBE AQ04 (fixed type) has already been submitted for barangay Vito. Sagay City is also considering either AQUA CUBE AQ00 type or AQ04 type for Molocaboc if enough raw water (rainwater) can be collected. |
| 2 | Cadiz City | Quotation for AQUA CUBE AQ07 type has already been submitted. |
| 3 | Negros Occidental Province | Quotation for AQUA CUBE AQ07 type has already been submitted. The provincial government is considering the purchase of AQUA CUBE especially as equipment to distribute potable water during the occurrence of disaster. |
| 4 | Kabankalan Central Philippines State University | The university is considering installing AQUA CUBE in the campus to supply potable water to the students and staffs. |

d) Deployment plan of AQUA CUBE in the Philippines

Depending on the circumstances and situation of the target area, deployment methods of a suitable type of AQUA CUBE shall be considered.

Regarding the future deployment plan, the initial target is to deploy 3 AQUA CUBEs in Negros Occidental Province (one for Sagay City in Vito, one for Cadiz City and one for Negros Occidental Provincial Government). Simultaneously, with cooperation with a local manufacturing company, some parts of AQUA CUBE shall be locally manufactured and assembled to achieve cost reduction. This result will facilitate the deployment of AQUA CUBE to all over the Philippines.

(2) Self-reliant and Continual Activities to be Conducted by Counterpart Organization

For the sustainable operation of the water supply business by Sagay City, the following points are considered to be important.

a) O&M scheme

A sustainable O&M scheme was established and verified during this survey. For continuous operation of the project, each barangay needs to be motivated such that they will receive more benefit if they work harder. i.e. if they can sell more water, they will have more profit, and the same applies to Sagay City. Besides, Sagay City also needs to conduct regular training for the operators on operation of AQUA CUBE and daily water quality tests.

b) Expansion of water distribution areas and aim for higher sales volume

It is necessary to target more residents to increase the sales. Therefore, delivery service is necessary to expand the distribution area. Moreover, it is also necessary to conduct PR activities simultaneously to encourage more residents to purchase safe drinking water. Therefore, regular workshops and continual advocacy programs are essential, not to mention regular water quality analysis.

c) Preparedness for distribution of water during disasters

Sagay city DRRMC has successfully formulated a suitable scheme for using AQUA CUBE during disaster. To execute it during actual occurrence of disaster, Sagay city shall need to conduct disaster drills regularly and reconfirm the responsibilities of each party. It is also important to identify water sources that can be used during such disasters.

5. FUTURE PROSPECTS

(1) Impact and Effect on the Concerned Development Issues through Business Development of the Product/ Technology in the Surveyed Country

Apart from the target areas in this survey, there are many other areas with similar problem related to the supply of clean drinking water. Moreover, non-revenue water (NRW) due to leakage in pipelines as a result of aging pipes is also considered as a major problem in the Philippines.

Business development and dissemination of AQUA CUBE can address such development issues as follows.

- It will enhance the accessibility to potable water and contribute to the Mid-term Philippine development plan. Similarly, it can also contribute to achieving millennium development goals “to increase the population with access to clean drinking water”.
- It will be cheaper and efficient substitution for the existing water supply system with aging water pipes, which shall cost more amount of money to replace the old pipes with new ones.
- It will contribute to reduce diseases that are caused due to water contamination.
- It will ensure the supply of potable water in affected area during disaster occurrence.

(2) Lessons Learnt and Recommendation through the Survey

a. Lesson learnt through this survey

▪ Importance of interaction with local residents

During the survey, few incidents such as fire near AQUA CUBE installation site etc. occurred, which was rumored to be triggered by the opposition group of residents. However, after special inspection by Sagay City, it was clear that those were mere accidents.

It is very important to disseminate information to all residents and to make them understand that, the project is being implemented for their own benefit. It is also necessary to check if there are any negatively affected residents and take suitable action.

▪ Engagement of private entity for Counterpart support

Sagay City has been very cooperative throughout the survey and supported the

survey team in all possible ways. However, for counterpart members, the task related to the survey is simply an extra workload, in addition to their daily tasks. Due to this, sometimes, regular communications could not be conducted and in particular, reporting of monitoring data to Japan was delayed a number of times. Hence, it is advisable to engage a private entity to support the counterpart in such tasks related to this kind of projects.

- Selection of target group for distribution of containers to residents

Upon the launch of the water distribution in both barangays, Sagay City Mayor distributed 200 containers in each barangay for the residents for purchasing water from AQUA CUBE. However, many residents who actually received the containers were not seen purchasing purified water from AQUA CUBE. At a later date, additional containers were distributed mainly to the residents who regularly consume purified water from AQUA CUBE.

- Flexibility in survey implementation, depending on local needs and circumstances

Initially, it was assumed that most of the local residents would purchase purified water from AQUA CUBE if the selling price is affordable. However, only a few residents were consuming purified water from AQUA CUBE. One of the reasons was that, local residents were used to drinking deep well water even though the water was contaminated because they were not aware that it could harm their health. Moreover, the residents were hesitant to drink river water even though it was purified. To cope with such unexpected situation and for awareness on potable drinking water, regular workshops needed to be held more frequently than the initial plan.

b. Recommendations to Sagay City

- For sales increment

Regular Workshops : Regular workshops and advocacy programs are necessary to raise the awareness of residents toward clean and safe drinking water. The more they are aware about their health, the more they will purchase purified water.

Delivery service of water containers : To distribute purified water to residents who live far from the AQUA CUBE installation site, introduction of delivery services is necessary. With the delivery service, not only the residents in the barangay, but also from the neighboring barangays will be benefited from AQUA CUBE, which will

lead to sales increment.

- For sustainable operation and management of the project and its expansion.

According to the financial analysis of water supply business with AQUA CUBE stated under “Activity 5”, the marginal number of containers to be sold daily is 43 without delivery service. On the other hand, with delivery service, the marginal number of containers is 49 per day. Therefore, to make the water supply business profitable and hence to make it sustainable, it is necessary to sell out more than the marginal number of containers.

In another case, if 360 containers (equivalent to 4 hours operation of AQUA CUBE) can be sold per day for 15 PHP per 20 L (without delivery service) and 25 PHP per 20 L (with delivery service), the daily profit will be 4,255 PHP and 5,566 PHP per day respectively. This implies that a new AQUA CUBE can be purchased for another barangay within 2.4 years (without delivery service) and 1.8 years (with delivery service) from the water supply business using AQUA CUBE. Hence, this will not only ensure the sustainable operation of the business but also guarantees the business expansion within a short period of time.

Similarly, the revenue is divided between Sagay City and each barangay as a catalyst to motivate each barangay for voluntary actions toward increment of sales. Such kind of incentive oriented operation and maintenance scheme is important for sustainability of the water supply business.

- Regular disaster drills using AQUA CUBE

For smooth operation of water distribution during disaster, it is important to conduct drills and trainings regularly using AQUA CUBE. This kind of drills and training will not only ensure smooth operation and safety of the machineries but also avoid unexpected troubles.

ATTACHMENT: OUTLINE OF THE SURVEY

Verification Survey with the Private Sector for Disseminating Japanese technologies for Portable All-in-one Water Purification System

INADA Inc., Kagawa Prefecture, Japan

Concerned Development Issues in the Philippines

- Many people do not have access to potable water due to poor water supply system. People suffer from various diseases due to consumption of contaminated water.
- Water supply system is critical due to aging pipes and need to be replaced by low cost water supply mechanism that is affordable to local residents.
- Emergency supply of potable water during disasters need to be ensured.

Implemented Activities in the Survey

- AQUA CUBE is installed in two barangays that do not have water supply system, in order to provide potable water at affordable price to the local residents.
- Verified the operation and maintenance scheme of AQUA CUBE by Sagay City in coordination with the local barangay staffs and other local entities.
- Established emergency water distribution system in Sagay City during occurrence of disasters by using AQUA CUBE.

Proposed Products/Technologies



AQUA CUBE

(All-in-one Water Purification System)

- ❖ It is a portable water purification device that consists of built-in water purification equipment, power generator and water storage tanks.
- ❖ It has automatic cleaning function due to which, the filtration membrane can be used for long term (exchange of membrane once every 5 years). It is highly energy efficient and the O&M is simple.
- ❖ It is compact in size and can be loaded into a truck to move it during emergencies at the time of disasters for supplying drinking water.

Survey Overview

Name of Counterpart: Sagay City

Survey duration: January, 2015 to August, 2016

Survey Area: Barangay Colonia Divina & Barangay Baviera

Impact on the Concerned Development Issues in the Philippines

- Locally available water sources such as river, rain, irrigation canals can be instantly purified to supply potable water to the residents.
- Diseases due to contaminated water can be prevented after the residents use purified water from AQUA CUBE.
- Potable water becomes accessible to the residents at affordable price.
- Supply of potable water can be ensured during the occurrence of disaster.

Outputs and Outcomes of the Survey

- Installed AQUA CUBE in two barangays to distributed potable water to about 6,000 residents at affordable price.
- Established emergency supply system of portable water in Sagay City during occurrence of disaster by using AQUA CUBE.
- Clarified the advantages of AQUA CUBE over other existing water purification systems to Sagay City and other LGUs.
- Formulated suitable deployment method of AQUA CUBE in the Philippines.